Driving Transformation and Sustainability in Manufacturing through Enterprise Product Lifecycle Management
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As economies worldwide gain new levels of maturity, issues of sustainability and social responsibility — both from a regulatory compliance perspective and a customer awareness point of view — have become key value drivers for manufacturing organizations. Process and discrete manufacturing organizations are grappling with the double-edged sword of risk and opportunity. Manufacturing organizations should leverage Product Lifecycle Management (PLM) programs and transform their business processes to not only enhance business performance, but also promote sustainability within the enterprise. Most organizations use PLM programs for improving the efficiency of engineering functions. However, we have found that extending the use of PLM to transform business processes related to sustainability can earn far bigger rewards for organizations.
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Introduction

Manufacturing organizations that adopt a strategic approach towards driving a Project Lifecycle Management (PLM) program experience greater benefits than the organizations taking a technology-centric approach. Most organizations make the mistake of treating a PLM implementation program as a mere technology intervention relevant only to engineering functions when that is not the case.

PLM systems, in addition to core engineering, enable transformation in manufacturing process management, customer relationship management (CRM), supplier relationship management (SRM) and enterprise resource planning (ERP) driven processes. Sustainability is driven by the products managed by processes and its key enablers are greener products, greener product lifecycles, greener operations, PLM-driven waste reduction, energy efficiency improvements, and efficient and lean processes.

In this paper we discuss how organizations can achieve operational excellence through transformed and sustainable businesses, and garner big rewards through well envisioned and executed PLM programs. The paper draws on the knowledge and experience gained by our subject matter experts over the course of various end-to-end global engagements, backed by ongoing research and studies.

Trends in the Manufacturing Industry

Let us look at some key industry trends and the corresponding imperatives that indicate the need for transformation in the manufacturing industry:

- Mergers, acquisitions and business alliances give rise to the need for aligning business processes to meet evolving customer preferences and demand fluctuations.
- Increasing globalization of products and operations (design, build, sell and maintain anywhere) means that an enterprise will have to adopt a collaborative approach and rely on tools for managing global operations.
- Frequent realignments of the business model and internal structure of an organization require boundary-less operations to bring higher agility and eliminate disjointed functions.
- Increasing product and business complexities put immense pressure on organizations to be innovative, lean and agile to handle these complexities.
- Manufacturers need improved efficiencies to manage cost pressures and are therefore increasingly exploring standardization, automation, rationalization and other similar options.
- The need for faster introduction of new products in the market underscores the need for reducing product lifecycle time. This requires organizations to improve the innovation management process, and hasten design turnaround time, along with enhancing success rates for ideation to commercialization.
- Products are required to be more environment friendly throughout the product life cycle (from design to manufacture and use, up to disposal) and thus there is a visible increase in initiatives to ensure optimum use of natural resources, along with sustainable design and supply chain practices.
Stringent regulations and norms are becoming commonplace, and to ensure compliance, organizations are introducing new tools and technologies and taking up initiatives to bring about organizational awareness.

What is at stake for manufacturing organizations?

Transformation helps organizations align themselves with the changing global trends, by adapting to new business models, altering organizational and business processes, and leveraging advanced technologies. The model shown in Figure 1 explains how the business vision must be intertwined through the entire process to reach the employees, and how the different tiers in the chain are tied to their enablers.

![Figure 1: One Organization, One Process Framework](source)

(Source: TCS Internal Research, underlying idea adapted from a presentation made at Siemens PLM Connection 2010)

Sustainability means finding the right balance between the social, economic and environmental aspects of a product and the business as a whole. Innovation in products and processes, frequent and effective new product introductions, cost focus, early design collaboration, leveraging of supplier expertise, and instilling quality in product design, are some important areas to improve sustainability in the product lifecycle. Organizations who deem long-term environmental sustainability as a key focus area have gained significantly in revenues, profit margins and customer loyalty. Figure 2 depicts the balancing act between these three major aspects of sustainable production — social, environmental and economic — and their results. The right balance makes a business truly sustainable. Otherwise it is merely bearable, equitable or viable.

To survive in an economically uncertain scenario, organizations need to be agile and flexible and should have a clear long term vision regarding their organizational and social growth.

Figure 2: Three Tenets of Sustainability
Why does the conventional approach fail?

The conventional approach for addressing business challenges is generally based on a reactive model in which organizations transform the local business unit or functional level processes and systems in response to certain external factors. This approach often starts with chalking out objectives to address the pain areas that have been identified by the local business units, and is dealt with primarily by enhancing system capabilities in order to overcome the known challenges. This reactive approach usually lacks vision and clarity of purpose, is weak on leadership commitment and does not have an enterprise-wide view. To make things worse, these are short to medium term programs. Our study and careful observation of such reactive programs has led us to identify some key challenges in this approach, listed in Table 1.

Table 1: Challenges in the conventional approach of transformation

<table>
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<th>Organizational</th>
<th>Environmental</th>
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<td>Lack of understanding of long term organizational vision</td>
<td>Challenges in developing an organization wide green culture – Reduce, Reuse, Recycle</td>
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<tr>
<td>Poor strategy definition</td>
<td>Lack of long term vision and strategy to support sustainable product development</td>
</tr>
<tr>
<td>Challenges of organizational change management due to global business and cultural diversities</td>
<td>Lack of processes to support green product lifecycle</td>
</tr>
<tr>
<td>Lack of organizational structure and cultural barriers hindering agility and flexibility to support the global competitive environment</td>
<td>Lack of mechanisms to manage environmental compliance, traceability and reporting across product lifecycle</td>
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<tr>
<td>Lack of integrated processes and tracking mechanisms for efficient management of resources, systems and tools</td>
<td></td>
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<tr>
<td>Lack of systematic investment and planning towards innovation management, lean approach and collaboration</td>
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How can PLM help?

PLM, like lean manufacturing, is a product and process management methodology that has the potential to transform a manufacturing enterprise. PLM concepts and IT enablers for PLM systems have reached new levels of maturity. With some help from niche products, and recent strides in next generation technologies such as intuitive user interfaces, cloud computing, social media, enterprise mobility and analytics, PLM promises a lot more now than in the past.

Figure 3 depicts how PLM provides a collaboration platform between entities and systems within and outside the organization. It functions as an integration backbone to tie all the business critical systems together so that the business can innovate faster, reduce costs on a regular basis, enhance quality, and collaborate globally.

Figure 3: PLM- Enterprise Solution
Figure 4 shows the building blocks of PLM, which when considered in conjunction with business intelligence, unstructured data, predictive analysis and knowledge management, result in a comprehensive solution. Incorporating tools like knowledge management, business intelligence, and analytics into a PLM implementation, increases the qualitative business benefits to the organization in terms of better efficiency and effectiveness, thereby providing a competitive edge. However, it is also important to understand that the benefits from these tools are not instantaneous, but will take time to bear fruit.

A PLM program provides a unique opportunity for companies to take a critical look at their business processes and ensure that they are completely aligned to business objectives. Figure 5 depicts how the key imperatives of a PLM program are drawn from the organization’s vision and are directly linked to the entire NPI value chain, thereby enabling the organization to achieve its objectives. The diagram also shows how PLM touches the four key aspects of any organization i.e. people, process, practice and technology.
As stated earlier, finding the right balance between the social, environment and economic aspects is critical to ensure sustainability. This can be achieved by including design analysis, environmental analysis and economic analysis during the early stages of the new product development process. Introducing these practices, through a PLM program (transformation) helps embed them into the fabric of the business processes. The orchestration of the key product and process aspects has been explained in Figure 6\(^3\). In the model shown below, the impact ranking of the product and process improvements on the three aspects are mapped on a scale of 1 to 5, and it can be seen that the combined effect is balanced in total. Only an enterprise-wide PLM program can enable this balancing act well.

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Many experts agree that PLM can not only bring about effectiveness and efficiencies on an exponential basis, but also support continuous improvement on an on-going basis. Some of the benefits:

1. Tracking of material, substances and their weight management throughout the product lifecycle
2. Risk and hazard impact analysis, thus reducing the possibility of litigation and related costs
3. Digital manufacturing⁴ (digital simulation) to ensure:
   a. Optimum use of energy, material and other resources during manufacturing processes
   b. Optimized plant layout with efficient material movements
   c. Minimal impact on environment by improving disposal standards and analyzing the use of air, water and energy
   d. Use of the best possible technology
   e. Efficient automation thus reducing time and resource requirements of processes
4. Data management to ensure:
   a. Availability of correct information to make the ‘trade-offs’ or to make the ‘course corrections’
   b. Analysis of the impact of change to gain better insights into cause and effect
   c. Traceability/audit of the data (capture, analyze, release with authorization, report, compile and correlate the conformance data)
5. Supporting virtual collaboration while reducing paper-based information and travel thereby contributing to making the earth a greener planet

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It should not be assumed that there will not be hurdles along the way, and these may occur at the very beginning itself. Thus, a transformation and sustainability program of such magnitude requires a strong business case to ensure alignment with business policies and objectives, along with commitment at all levels. A clear roadmap for realizing business benefits, and a foolproof mechanism to track, maintain and enhance business improvement metrics over the program tenure and beyond are other imperatives for a successful implementation of the program.

Solution approach and framework

Having established the need for executing an enterprise transformation program, the question that next comes to mind is “How do we get there?”

Drawing on our extensive consulting experience, we have arrived at a standard methodology to create a business case for large transformation programs. The process begins with listing the existing processes and systems and their associated metrics at different levels. This allows for the prevailing performance metrics to be comprehensively identified, verified and base-lined.

Figure 7 depicts the high level framework that explains the various stages between strategy and implementation along with the building blocks of strategy formation and the steps in managing transformational PLM programs.
Some game changers built into the framework include:

- Multi-faceted business case defining strategic business imperatives to set measurable goals
- Scope management and roadmap based on building block approach for faster ROI
- Prioritization for investment
- Performance metrics driven implementation program
- Collaboration, communication, cooperation amongst cross-functional teams
- Focus on product innovation process

Why settle for less when you can get a whole lot more?

The benefits of a successful PLM program cannot be generalized — they depend greatly on the vision and execution of the program. In our experience, organizations have reaped the following benefits from their PLM implementation:

- Reduction in time to launch a new product – range 20 to 35%
- Reduction in product development cost – range 20 to 25%
- Reduction in scrap, redundant inventory – range 30% or more
- Improvement in resource utilization – range 20 to 30%
- Improvement in engineering changes turnaround time – range 20% or more
- Improvement in engineer productivity – range 25% to 40%
- First time right performance improvements – time to launch and time to volume improvements (range 20% or more), cost of poor quality improvements (range 25% or more)
- Individual process cycle time improvement – range 20% to 50%
- Share of business from new products – increase of 10 to 25%
- Customer Satisfaction Index – improvement in areas of responsiveness, communication, accuracy of information and costs
- Variety reduction and reuse – 20% in some industries
Case in Point: Some organizations are well ahead

A leading Indian farm equipment manufacturer aimed to transform the New Product Introduction (NPI) processes and systems - a big step towards sustainability - as the environmental aspects were built into the transformed processes (see figure 8).

About the Client
- Leading manufacturer of farm equipment in India having a turnover of approx. USD 1 billion.
- Sells and distributes its products and services in Asia and other continents through 500+ dealers.
- With a team strength of 150 design engineers, it has a wide variety of product platforms and variants produced through a global network of manufacturing facilities.

Business Challenge
- Poor management visibility into new product development process.
- Lengthier and iterative new product introduction resulting in cost and time overruns to the tune of 40%.
- Costly recalls post launch due to product quality issues.
- Late engineering changes costing in excess of 25% costs of the new products.
- Complex product portfolio with high variety and low volume.
- Collaboration between various functions/stakeholders.

TCS’ Solution
- Comprehensive process studies, gap analysis, and to-be process design (NPI, BOM sync, ECM).
- Deployed TCS proprietary tools and frameworks (PO matrix, NPI canvas, V-model, etc.) to perform deep dive analysis.
- Recommended industry best practices to overcome challenges in New Product Innovation (NPI).
- Developed multi-layer NPI metrics and dashboards to create visibility in product introduction across the enterprise with built-in analytics options.
- Conducted detailed product assessment for selection of suitable PLM tools and laid out the implementation roadmap.

Business Benefits
- Better control over NPI through cost control
- Efficient management of product portfolio through NPI canvas with 4 flavors
- Robust project planning and resource allocation
- Reduction in NPI cycle by 30%
- Significant reduction in late engineering charges
- Increased utilization charges
- Integrated common view of NPI process across the enterprise
- End-to-end visibility of NPI process (design to service)
- Ensure right first-time-products to market

Figure 8: How a leading Indian farm equipment manufacturer transformed its New Product Introduction (NPI) processes and systems
Conclusion

Undertaking PLM initiatives as an enterprise-wide transformational program with sustainability at the very core is far more beneficial than merely focusing on the technological aspects. Such initiatives unleash several benefits and fully justify the huge investments a PLM program demands. A sustainability and business transformation-centric approach for a PLM implementation program may be beset with multiple challenges, and therefore mandates a long term and a clear PLM vision. Such an initiative requires prolonged leadership commitment and sustained organizational support since benefits may not be immediately apparent or realizable. Hence organizations embarking on a PLM implementation initiative must evaluate the business case in light of the benefits discussed above. To reap maximum benefits, such an initiative requires meticulous project planning, creation of frameworks and planning set in place at the very beginning.

In conclusion, we would like to propose the following guidelines for a successful PLM implementation:

- Set a clear vision for the PLM Program
- Secure buy in and commitment from all stakeholders
- Devise a well thought out long term and sustainable strategy for PLM-led transformation
- Formulate strategies to strike a balance between the economic, environmental and social aspects of the Product Development process
- Develop a roadmap and organization structure to support the PLM-led transformation
- Use PLM as a technology enabler to support the integrated processes and the cross-functional teams
- Provide the right amount of focus and drive to enable successful Organization Change Management
About the Manufacturing Solutions Unit

Global manufacturers are trying to reduce operational expenditure, invest in process improvement, utilize existing capacity optimally and increase efficiencies, while maintaining product quality and meeting safety and regulatory norms. TCS’ Manufacturing Solutions provide you the bandwidth to innovate on business models, leveraging contemporary technology solutions.

We believe in leveraging learning from across the segments in developing business solutions. Be it in applying the concepts of lean new product introduction from discrete industries to a chemical manufacturer, or leveraging the aerospace industry experience in service management for the automotive sector, our dedicated Manufacturing Centers of Excellence (CoEs) under these focus vertical industries are continuously looking at breakthrough solutions. Clients can benefit from our rich experience in both the discrete (automotive, industrial machinery and equipment, aerospace) and process industries (chemicals, cement, glass and paper).

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